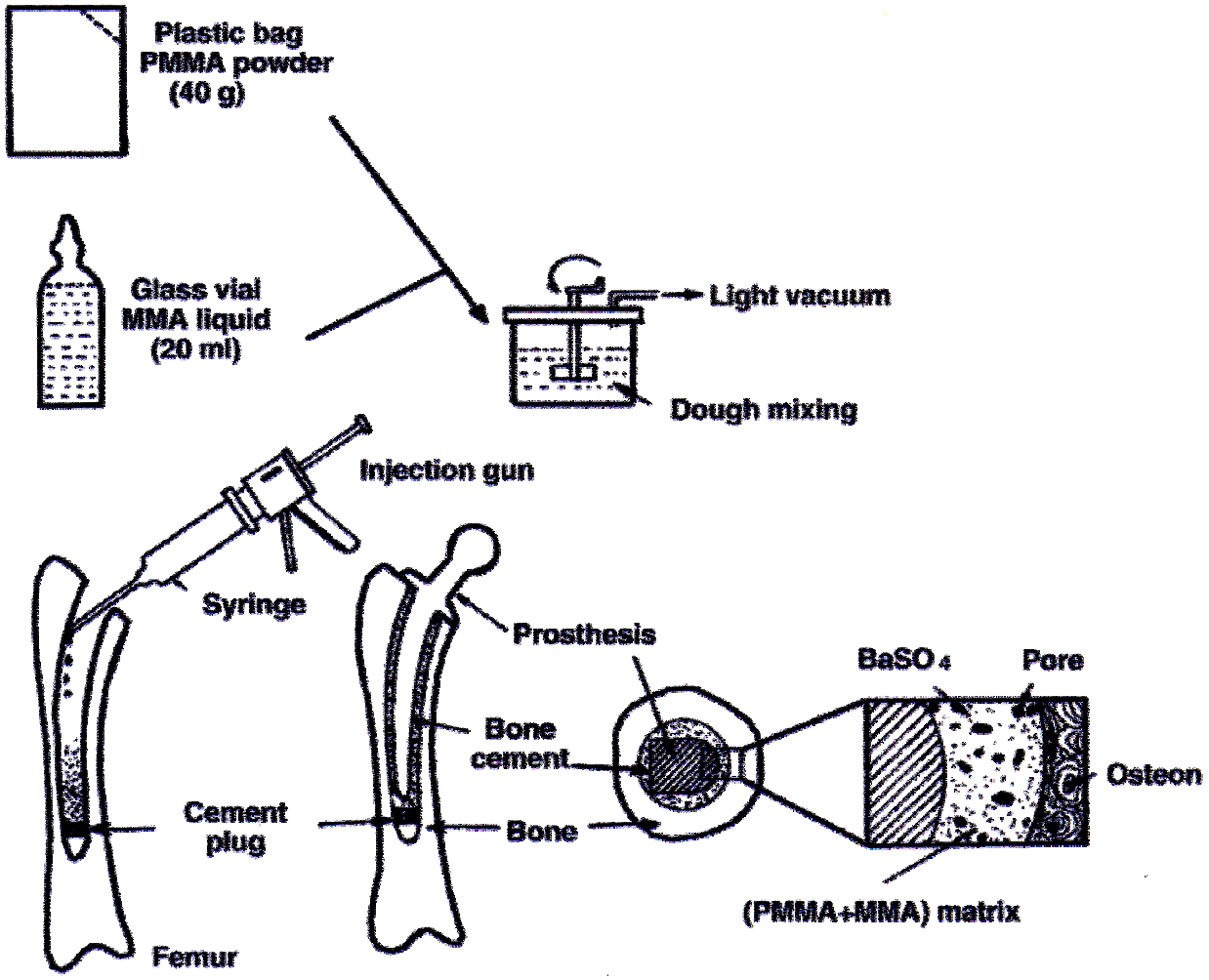
Curing of bone cement

- Mixing of components in a ratio of ca. 2:1 (Powder:Liquid) in the operating theatre shortly before the implantation
- Radical polymerisation causes a local temperature raise up to 46 °C by the polymerisation heat
- Remaining time for the surgeon ca. 10 to 12 min until complete curing
- Liquid monomer is cytotoxic -> Application only after a delay of ca. 4 to 5 min from starting the mixing
- Quality of the polymerised cement depends on the mixing technique and the application mode

Schematic illustration of a hip joint replacement procedure using bone cement



(J. Park / R.S. Lakes, 2007)

Bone Cement

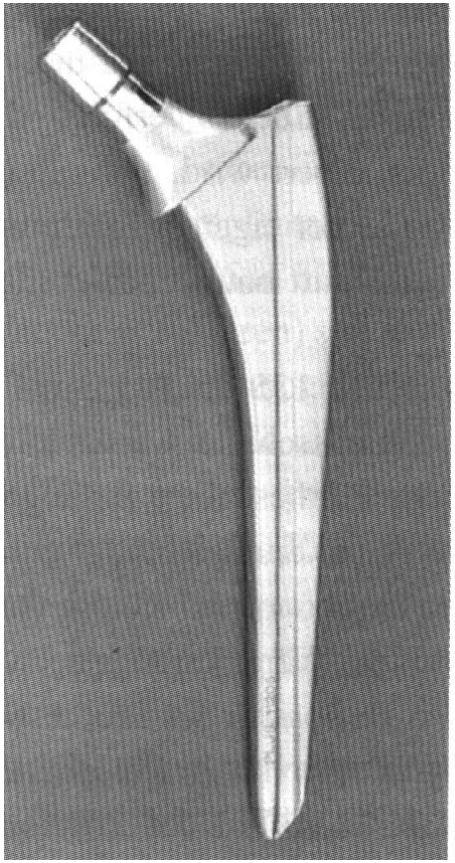
- Final properties depend on mixing technique, application and composition
  - Porosity
  - Temperature
  - Humidity
  - Ratio powder/liquid
  - Powder and monomer composition
  - Powder particle size distribution
  - Molar mass

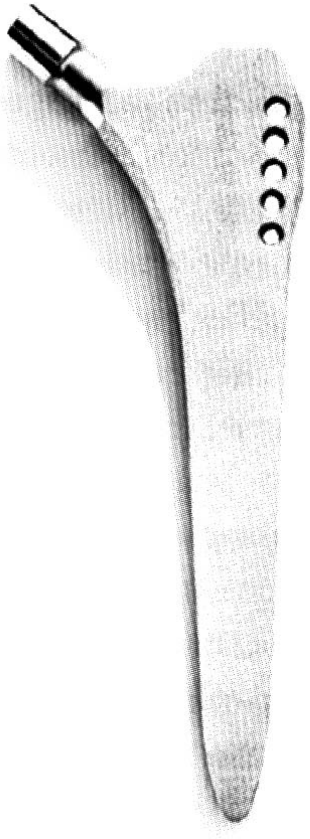
Mechanical Properties of Bone Cement (Static Loading)

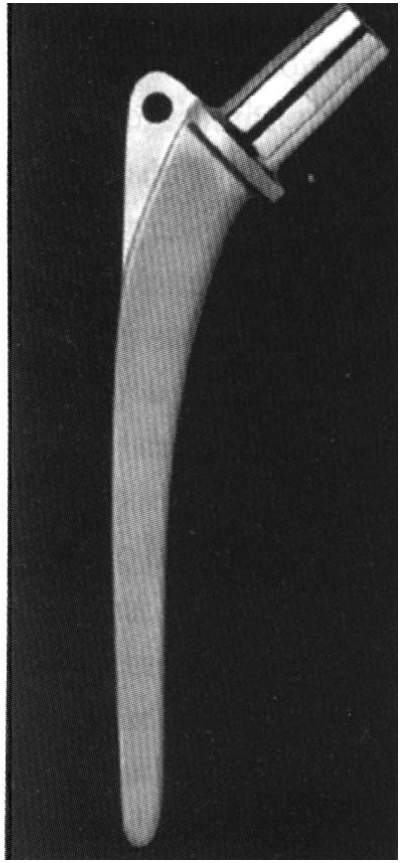
Property		
E Modulus (tensile)	(MPa)	2400 – 2800
E Modulus (compression)	(MPa)	2400 – 2800
Tensile strength	(MPa)	24 – 48
Compression strength	(MPa)	77 – 92
Shear strength	(MPa)	41
Flexural strength	(MPa)	50 – 82
Fracture Toughness	($MN/m^{3/2}$)	0.88 – 1.55

Bone Cement

- Disadvantages:
  - Exothermic polymerisation temperature
    - Temperatures up to 124 °C
    - Evaporation of monomers
    - Expansion of air inclusions (+ 10 % Vol)
  - Reaction shrinkage (– 22 % Vol)
  - Reaction depends on temperature and moisture
  - Residual monomer
    - Allergic
    - Toxic
    - Can lead to chronic damage
  - Difficult reoperation







Straight Stem

Stainless steel
forged
cemented

TiAl6Nb7
forged
cement free

Bow Stem

CoNiCrMo
forged

(E. Wintermantel / S.-W. Ha, 2002)

Straight stem PLUS cemented

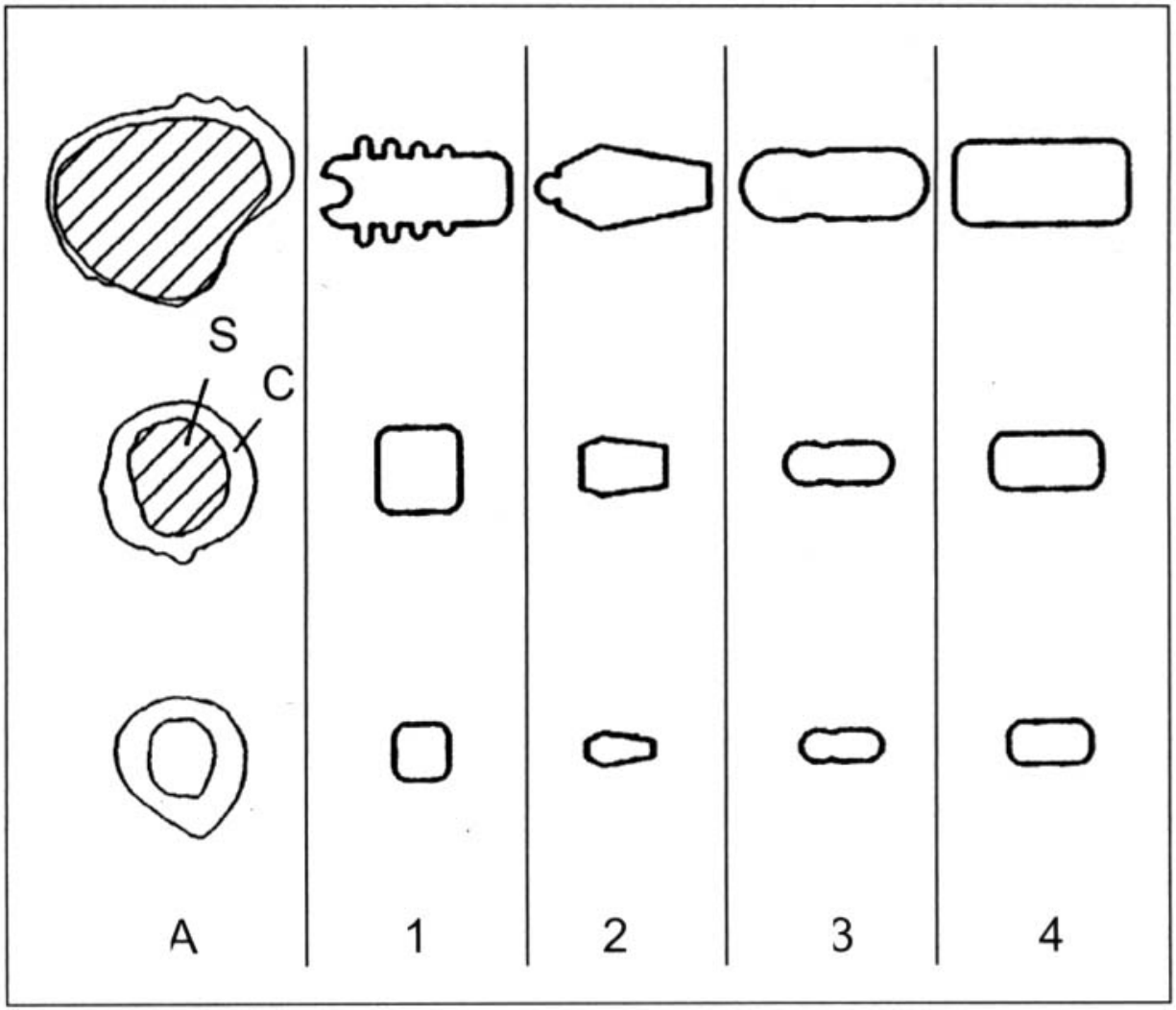
first operation

2 sizes (Length 183 and 199 mm)
Stem consists of a forged stainless steel according to ISO 5832-9

revision operation

180 to 230 mm length (original prosthesis bed has to be extended)

www.plusorthopedics.co.at



Scaled cross section of the femur (a) and corresponding cross sections of four different commercial artificial stems (S … Spongiosa, C … Cortical bone)

(E. Wintermantel / S.-W. Ha, 2002)